Response of soybean and lentil to a seed-row placed nitrogen- phosphorus fertilizer blend in a Brown Chernozem in south-central Saskatchewan

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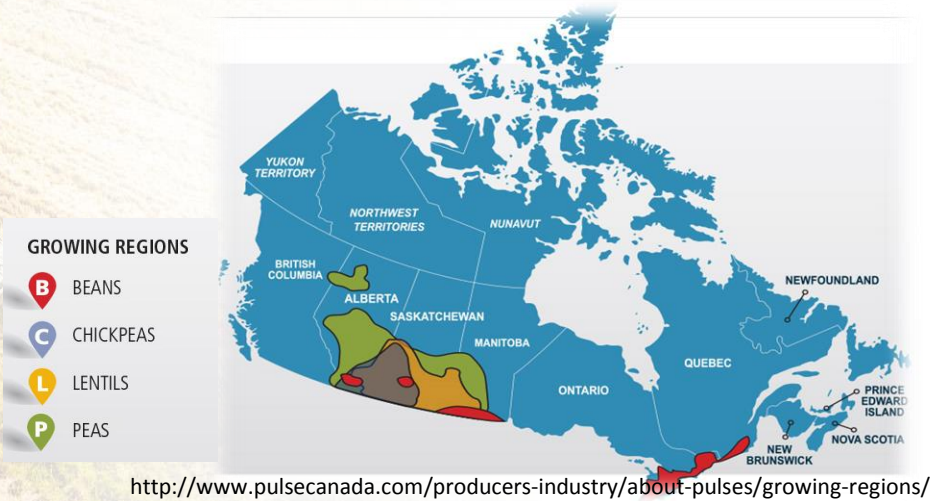
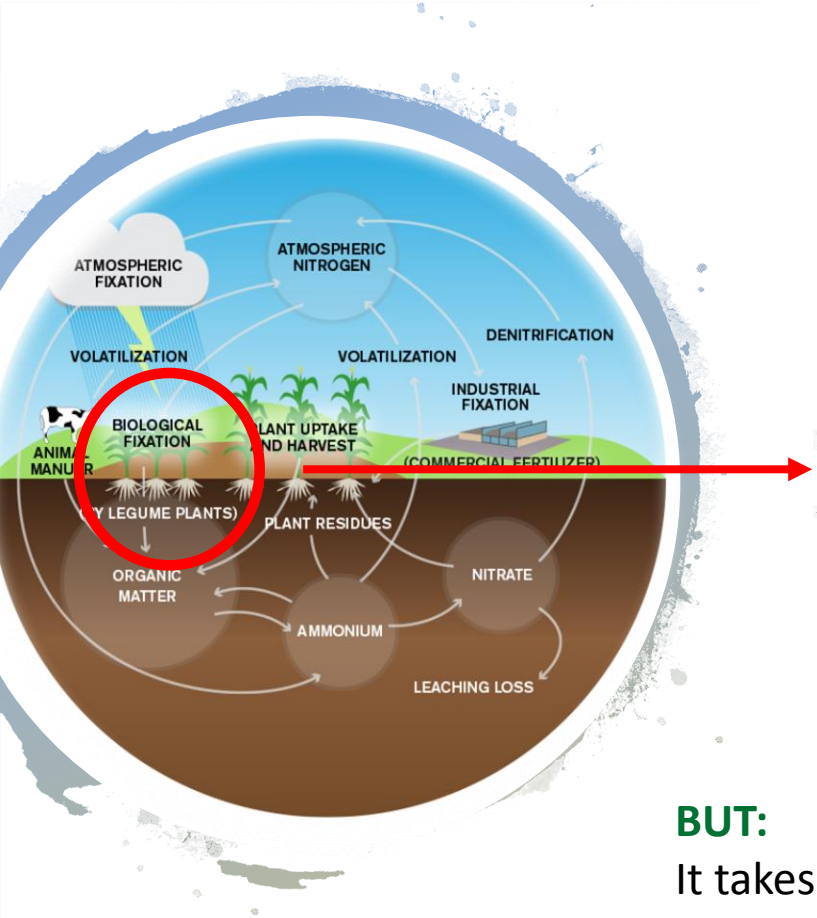
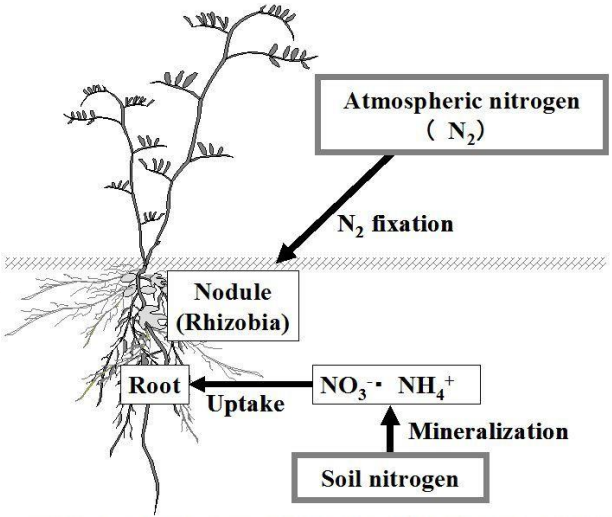
Introduction

- In 2016, Canadian pulse production hit a record high of 8.4 million tonnes
- Saskatchewan is well-suited for growing lentils, peas, beans, chickpeas, faba and soybean



http://www.pulsecanada.com/producers-industry/about-pulses/growing-regions/





BUT:

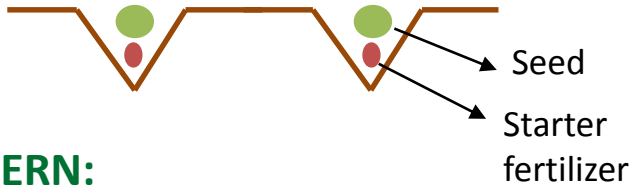
It takes one to two weeks (or longer) for a legume to establish nodules

THEN;

Plant may suffer “early” N deficiency

THEREFORE:

In seed-row placement of N with P as “starter” nutrient



CONCERN:

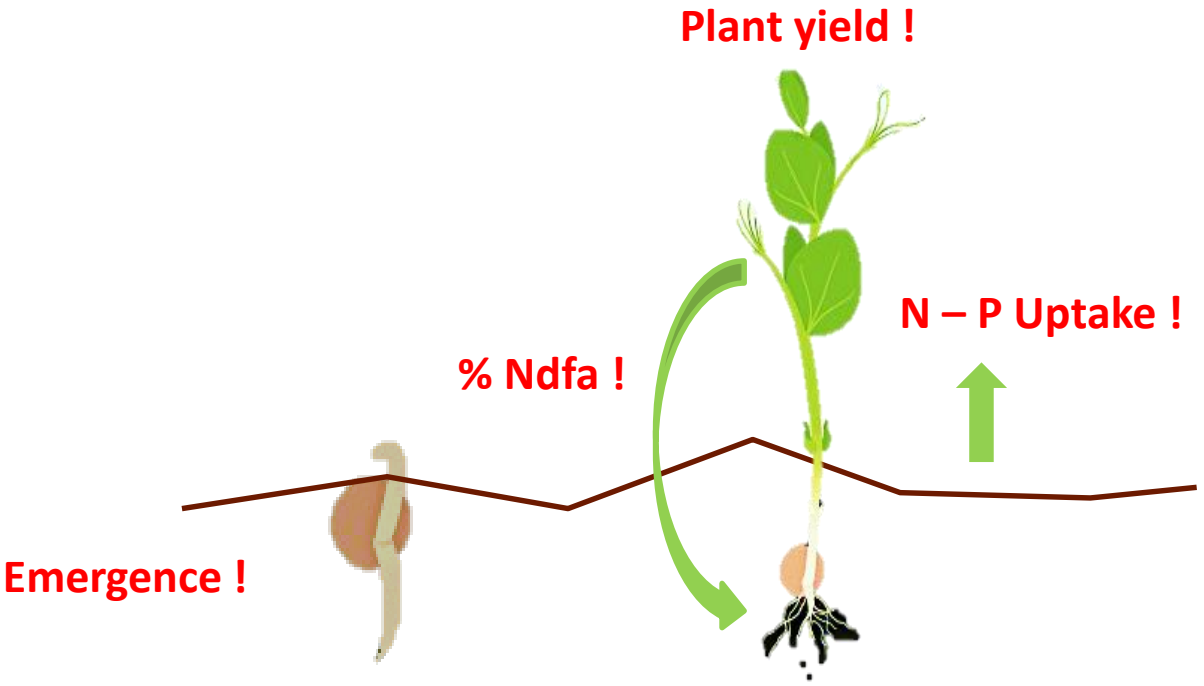
Seed-row placed N along with P can increase injury, reduce emergence

RESEARCH QUESTIONS:

How much N+P can be safely placed in seed-row?

What is crop response to starter N + P?

Objectives:



- 0 kg N,P_2O_5/ ha
- 10 kg N,P_2O_5/ ha
- 20 kg N,P_2O_5/ ha
- 30 kg N,P_2O_5/ ha

Research objectives:

- To evaluate the effect of seed-row placed N-P fertilizer blend of 50% urea and 50% MAP (blend analysis 28-26-0) on emergence of soybean and lentil in order to establish maximum safe rates
- To reveal how starter seed-row placement of fertilizer (N-P) blend affects growth response, specifically on final grain and straw yield and N, P uptake under field conditions
- To determine the N fixation of soybean using ^{15}N label and non-fixing wheat reference crop

Methods

- **RCBD in 2018**
- **Site;** near Central Butte SK in Brown SCZ
- **Crops :** soybean, lentil
- **N rates;** 0, 10, 20, 30 kg N,P_2O_5 ha^{-1}
- **Fertilizer:** 28-26-0 (50:50 blend of urea and MAP)
- **Data collected;**
  - 19 day plant emergence counts
  - grain and straw yield and N and P uptake
  - % ndfa in soybean using ^{15}N dilution technique (wheat as a reference crop)

2018 Field Study

- Site preparation for 1m x 3m plots
- Inoculation and seeding, 28-26-0 placed in seed-row with soybean, lentil
- ^{15}N application to 1m x 1m subplots of soybean and wheat
- Emergence counts after 3 weeks
- Harvest, threshing, determine yield, N and P uptake, ^{15}N in grain and straw

Results

- Emergence count
- Grain and straw yield
- N and P uptake
- %Ndfa

2018 Central Butte study site soil and environmental conditions

Depth	Soil Property						
	P†	N‡	S§	K†	pH¶	EC#	OC
(cm)	-----mg kg soil^{-1}-----					(dS m^{-1})	(%)
0-15	4.9	6.0	3.4	337.1	7.7	0.2	1.6
15-30	-	4.8	4.5	-	7.8	0.2	-
30-60	-	3.6	7.6	-	7.9	0.3	-

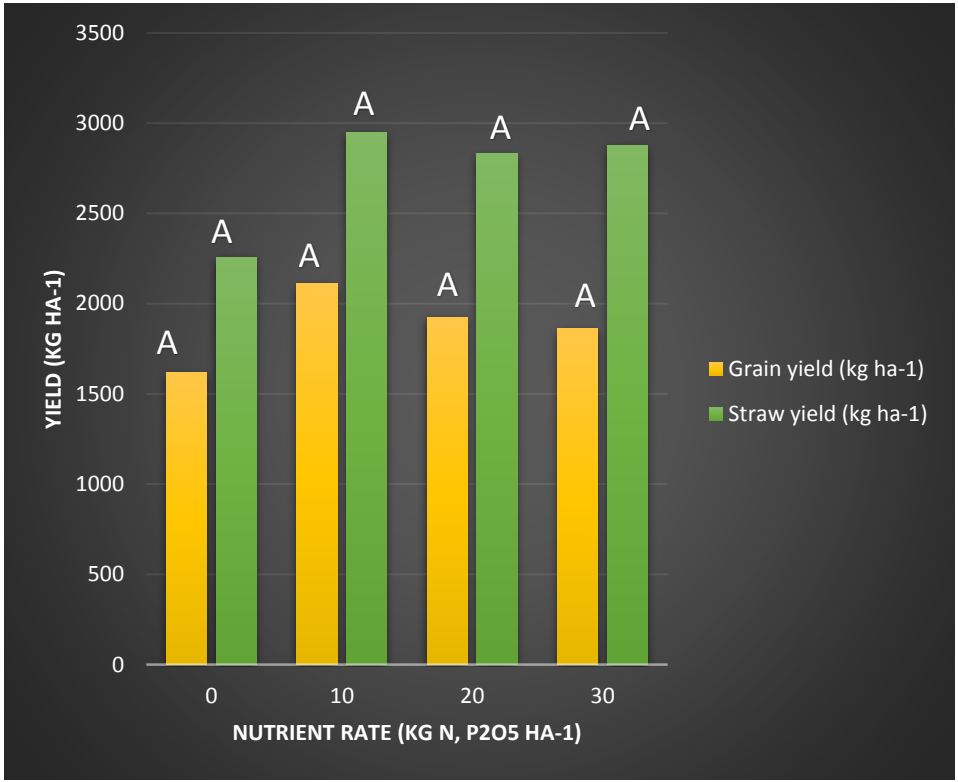
	Mean Monthly Temperature (℃)		Mean Monthly Precipitation (mm)	
Month	2018	HM	2018	HM
May	15.0	12	40.9	51
June	18.3	16	46.1	77
July	19.3	19	34.1	41
August	17.8	17	39.4	42
September	8.1	12	37.5	23

Emergence

Fertilizer Rate (kg N, P_2O_5 ha^{-1})	19 Day Emergence Count	
	Soybean	Lentil
0	16^{a}	39^{a}
10	15^{a}	37^{a}
20	11^{b}	23^{b}
30	13^{ab}	31^{ab}
SEM	1.3125	3.6647
F value	4.36	3.97
Pr > F	0.027	0.0272

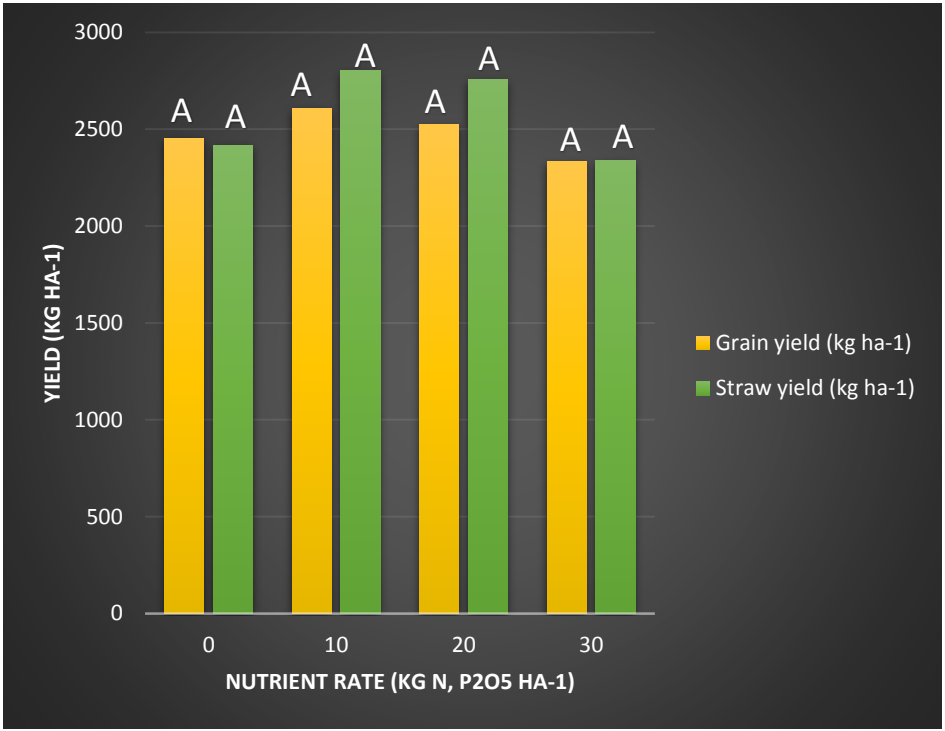
- At 20 kg N, P_2O_5 ha^{-1} rate, emergence significantly reduced by seed placed urea-MAP blend for both soybean and lentil

Grain and straw yield - Soybean



- Mean soybean yield increased with 10 kg N,P_2O_5 ha^{-1}
- But no yield benefit above

Grain and straw yield - Lentil



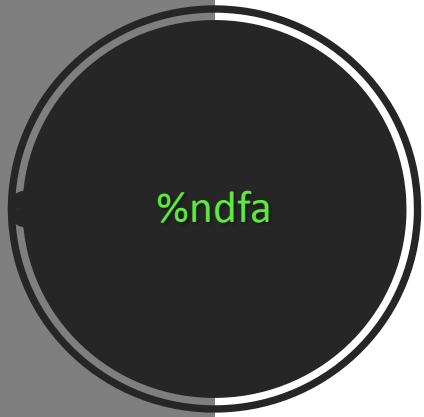
- Highest mean lentil yield is at 10 kg N,P_2O_5 ha^{-1} but no significant different among treatments

N and P uptake

Fertilizer Rate (kg N, P_2O_5 ha^{-1})	Soybean			
	Grain		Straw	
	N uptake	P uptake	N uptake	P uptake
	kg ha^{-1}			
0	70.5[a†]	5.7[b]	7.9[a]	0.9[b]
10	93.0[a]	8.8[a]	9.9[a]	1.2[ab]
20	83.5[a]	8.5[a]	9.8[a]	1.2[ab]
30	80.5[a]	8.4[a]	10.4[a]	1.3[a]
SEM	12.3248	0.988	1.1116	0.1312
F value	0.79	3.83	1.09	1.77
Pr > F	0.5227	0.0425	0.394	0.1952

Fertilizer Rate (kg N, P_2O_5 ha^{-1})	Lentil			
	Grain		Straw	
	N uptake	P uptake	N uptake	P uptake
	kg ha^{-1}			
0	79.8[a]	6.2[a]	14.1[b]	1.6[a]
10	87.3[a]	6.6[a]	15.5[a]	1.8[a]
20	83.4[a]	6.7[a]	16.8[a]	1.8[a]
30	77.3[a]	6.2[a]	14.2[ab]	1.7[a]
SEM	4.3574	0.3003	0.8421	0.1178
F value	0.89	0.75	2.21	0.84
Pr > F	0.4666	0.5369	0.129	0.4909

- Mean N uptake increased in both crops



Fertilizer Rate (kg N, P_2O_5 ha^{-1})	Ndfa‡ %	
	Grain	Straw
0	81.1[a†]	71.3[a]
10	78.8[ab]	60.0[a]
20	71.5[ab]	69.1[a]
30	70.9[b]	63.7[a]
SEM	4.2477	5.5644
F value	2.72	1.21
Pr > F	0.0907	0.3494

- Highest rate of added fertilizer decreased proportion of N in soybean derived from fixation

Important findings

- At this site 10 kg N/ha and 10 kg P_2O_5/ha added as 50%-50% blend of urea and MAP in seed-row was optimal starter rate:
  - It did not reduce emergence
  - Gave higher mean yield and N-P uptake than control
  - N contribution by fixation
- Adding more than 10 reduced emergence, %Ndfa and gave no yield benefit.

Summary:

Plant yield (Grain)

Soybean – 2100 kg/ha

Lentil – 2600 kg/ha

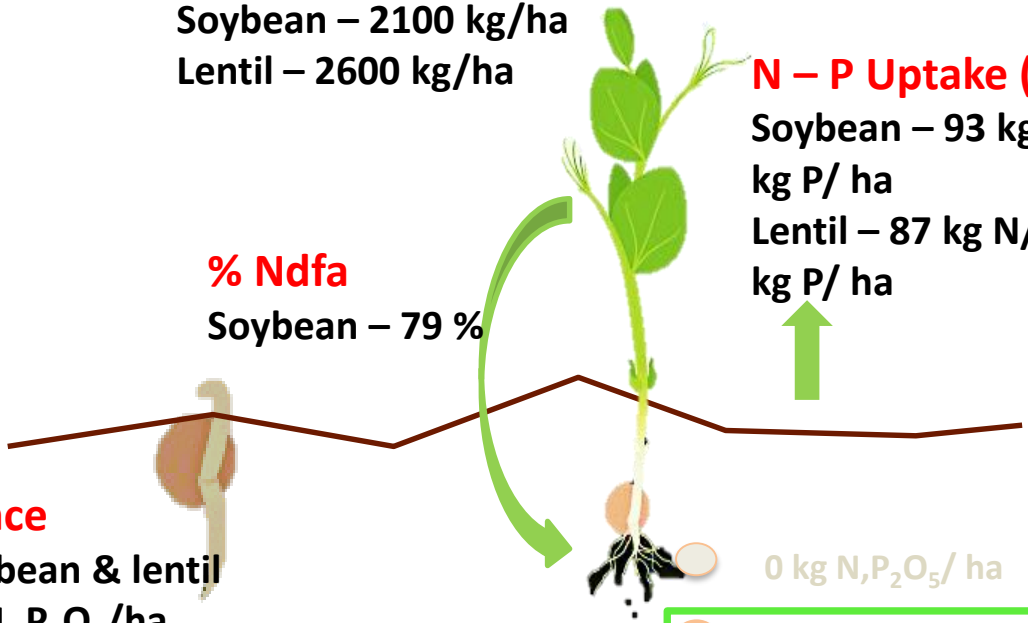
N – P Uptake (Grain)

Soybean – 93 kg N/ha, 8.8 kg P/ ha

Lentil – 87 kg N/ha, 6.6 kg P/ ha

% Ndfa

Soybean – 79 %



Emergence

~94% soybean & lentil at 10 kg N, P_2O_5/ha compared to control

- 0 kg N,P_2O_5/ ha
- 10 kg N,P_2O_5/ ha
- 20 kg N,P_2O_5/ ha
- 30 kg N,P_2O_5/ ha

Many Thanks!!!

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